



**CENTRE FOR ATMOSPHERIC RESEARCH**



# **ANNUAL REPORT**

## **2019**

**NATIONAL SPACE RESEARCH AND DEVELOPMENT AGENCY**

**FEDERAL MINISTRY OF SCIENCE AND TECHNOLOGY**

**KOGI STATE UNIVERSITY CAMPUS, ANYIGBA, NIGERIA**

*...Creating Opportunities*



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## DIRECTOR/ CHIEF EXECUTIVE'S STATEMENT



This year's annual report focuses on showcasing the achievements of our Centre as we continue to actualize our mandates and visions. The Centre for Atmospheric Research (CAR) is a world class research and development Centre of National Space Research and Development Agency (NASRDA) committed to research and capacity building in the atmospheric and related sciences, dedicated to understanding the atmosphere—

—the air around us—and the interconnected processes that make up the Earth system, from the ocean floor through the ionosphere to the Sun's core and provide research facilities/services for the atmospheric and Earth sciences community.

In 2019, we have sustained the pattern of conducting routine maintenance of our growing facilities with coordinated supervision by our team of engineers in several locations across the country. All of these activities have been captured in this report.

We are glad to report that the Space Environment Research Laboratory of CAR which houses some very important equipment used for probing the Space Environment was commissioned on the 25th of April, 2019 by the Honourable Minister of Science and Technology, His Excellency Dr Ogbonnaya Onu in presence of Senator (Prof) Robert Ajayi Boroffice (Pioneer DG NASRDA and Chair, Senate Committee on Science and Technology) and Prof. S. O Mohammed D.G NASRDA and other dignitaries.

In line with our mandate, we have continued to facilitate workshops, conferences, and staff trainings. The 3<sup>rd</sup> Ekundayo Elisha Balogun National Symposium and 2019 National Air Quality Workshop was held in Bowen University, Osun State. Also, the International Colloquium on Equatorial and Low-Latitude Ionosphere (ICELLI), was hosted by University of Lagos. Find details of these workshops and many more in the report.

CAR has continued to enjoy the benefits derived from the outstanding partnerships forged with collaborators over the years, especially in promoting research, field observations and capacity building in line with the Centre's mandates. We have continued to develop cooperation with many relevant national and international institutions. In August 2019, our Centre participated in a kick-off meeting of an international project to be funded to the tune of One Million Six



Hundred & Twenty-Nine Thousand Euro (€1,629,000,00) solely by the German Ministry of Education and Research (BMBF). Our collaborators in this project are the National Centre for Energy Research and Development, UNN and the German Institute of Energy and Climate Research (IECR), Julich, Germany.

CAR also hosted some visitors from Virginia Technology College of Engineering, Virginia, USA led by Prof. Wayne Scales of Virginia Tech, USA working in collaboration with Bowen University to set up the first ever Radar system equivalent in operation to Super Dual Auroral Radar Network (SuperDARN) in Africa.

Through our capacity-building, awareness-raising and outreach efforts, all highlighted in this report, we are confident that CAR will continue to deliver on her mandates while providing tools for scientists to conduct meaningful and relevant research with international competitiveness. CAR has and shall continue to build partnerships with relevant National and International institutions toward actualizing her mandates. To this end, the Centre has become an International reference Centre of Excellence 'CoE' for space weather research. We hope to continue to create more opportunities that will better the lives of people.

Our sincere appreciation to His Excellency, Dr Ogbonnaya Onu, the Minister of Science and Technology; Professor S. O, Mohammed, Ex-Director General/CEO NASRDA; and Mr Jonathan Angulu, the Acting Director General NASRDA; for their cooperation and unwavering support throughout the year 2019. The friendly work environment provided by our host community, Kogi State University, Anyigba is highly appreciated. Lastly, we acknowledge the contributions and team work displayed by all staff of the Centre throughout the year 2019.

We wish you a happy reading!"

**Professor Babatunde Rabi**

Director and Chief Executive  
Centre for Atmospheric Research,  
National Space Research and Development Agency,  
Federal Ministry of Science and Technology, Anyigba, Nigeria



## CENTRE FOR ATMOSPHERIC RESEARCH AT A GLANCE

Established on 2<sup>nd</sup> January 2013, the Centre for Atmospheric Research (CAR) is a world class research and development Centre of National Space Research and Development Agency (NASRDA) committed to research and capacity building in the atmospheric and related sciences, dedicated to understanding the atmosphere—the air around us—and the interconnected processes that make up the Earth system, from the ocean floor through the ionosphere to the Sun's core and provide research facilities/ services for the atmospheric and Earth sciences community.

Located in Anyigba, Kogi State to operate as 7<sup>th</sup> full-fledged activity Centre of NASRDA under the leadership of Professor Babatunde Rabiou from 2013 - till date. The Centre is a spin off from the Centre for Basic Science (CBSS), Nsukka, Enugu State.

The customary organization of International schools, conferences and workshops have positioned the Centre to be at the forefront amongst its peer. Part of these remarkable events are scientific meetings such as the 2<sup>nd</sup> Cyril Onwumechili School on Physics of Up-

per Atmosphere in 2013 with 65 participants drawn from across Nigeria and Benin Republic. The Centre also co-hosted with NCAR, Boulder, the 1<sup>st</sup> West African Workshop on Air Quality Measurement and Modelling in 2014 with tutors from NCAR, US and NCAR, UK. The Centre hosted the first annual conference of the continental African Geophysical Society in 2014. Furthermore, the Centre hosted an International School on Equatorial and Low Latitude Ionosphere ISELLI in 2015 which attracted over 40 participants from different countries. As at 2017, the 2<sup>nd</sup> International School on Equatorial and Low Latitude Ionosphere (ISELLI-2) hosted by CAR, saw over 60 participants from over 11 countries and 14 instructors in attendance. In 2018, CAR organised the 1<sup>st</sup> National Workshop on Air Quality in 2018 amongst many other events during the year.

CAR set up the first all-sky optical imager to be installed within the African continent in Abuja in June 2015. With this feat achieved, over a hundred (100) publications have been produced by the technical staff of the Centre and till date, some of these research articles have been published in high-ranking internationally recognized journals. Between 2013



and 2019, CAR has received about 6200 visitors both from overseas and within the country for different research purposes.

Summarily, CAR is involved in research activities that cover a wide range of eco-sphere from the bottom of the ocean, through the atmosphere to the centre of the Sun. Precisely, on 6<sup>th</sup> January 2018, we started the first daily nowcasting of the space weather condition in Sub-Saharan Africa. The data output obtained from this ingenious equipment has attracted global patronage toward the Centre and methodical analysis of this data has significantly contributed to the development of theses and publications in grey areas of research.

Today, CAR operates 28 weather stations under the TRODAN project, 4 GPS stations for Space Weather monitoring, 2 lightning monitor facility, all-sky Optical Imager, about 10 indigenously made magnetometers, 1 AMBER, 3 MAGDAS, 1 scintillation monitor, 1 Fabry Perot Interferometer, 1 SOFIE, 1 Ozone monitor, HF radio signal monitor and others.

Through the years, CAR has established the following network of observatories: (1) The National Air Quality Research Laboratory, University of Ilorin in 2014. (2) The Space Environment Research Laboratory (SERL) at the NASRDA HQ Abuja in 2015. (3) The Space-Earth Environment Research Laboratory (SEERL), University of Benin in 2016. (4) The Space Weather and Atmospheric Physics Laboratory SWAP Laboratory, Bayero University, Kano in 2017. (5) The Atmospheric and Space Weather Research Laboratory (ASWeRL), University of Osun State, Osogbo in 2017. (6) The Central Laboratory for Atmospheric Research (CLAR) CAR, Anyigba in 2017 and a host of others in the pipeline.

Through her notable track records, CAR has and shall continue to build partnerships with relevant National and International institutions toward actualizing her mandates. To this end, the Centre has become an International reference Centre of excellence for space weather research.



## MISSION STATEMENT

- To understand the behavior of the entire spectrum of the Earth's atmosphere and related physical, biological, and social systems
- To promote capacity development in relevant atmospheric sciences as a way of facilitating international competitiveness in research being conducted by atmospheric scientists
- To disseminate atmospheric data and products to users towards socio-economic development of the Nation

## MANDATE

The Centre for Atmospheric Research is to provide sound education, research and knowledge in the following areas:

- Lower atmosphere
- Upper Atmosphere (Ionospheric / Magnetospheric Physics)
- Atmospheric chemistry and environmental science
- Geomagnetism
- Environmental research
- Tropospheric and trans-ionospheric radio propagation research
- Solar physics, Solar Terrestrial Interactions, Space Weather
- Human space technology Initiative
- Space debris

CAR is envisioned to operate in 3 modes illustrated below:

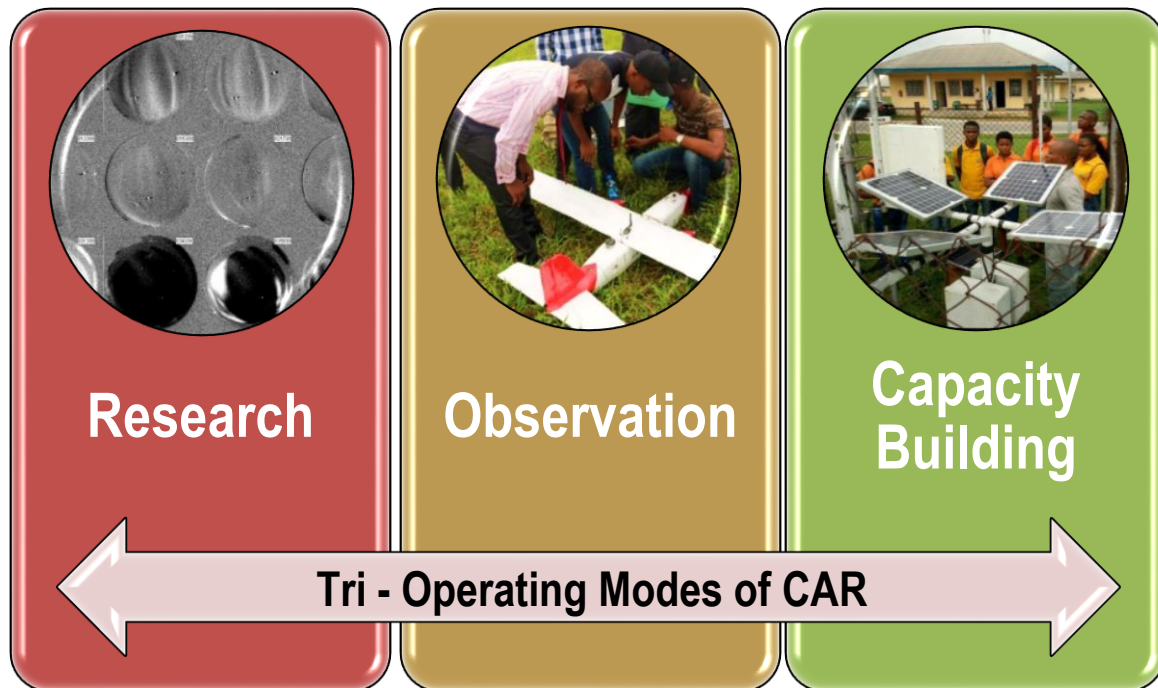


Figure 1: CAR Operating Mode

## MAJOR ACTIVE RESEARCH PROJECTS AT CAR

### Space Weather Observation Network over Nigeria -SWONON

### Space Weather Observation Network over Africa - SWONOA

- Network of ground-based space observatories including magnetometers, digisondes, Ionospheric GPS monitors and optical imagers
- Daily Space Weather Nowcasts
- Enhancement of performance of Space-based technologies

### Tropospheric Data Acquisition Network - TRODAN

- Network of ground stations monitoring lower atmospheric parameters i.e. automatic weather stations, Rain radar
- Improvement of space-earth communication systems
- Atmospheric Chemistry and Environment Research - ACER

- Establishment of network of stations monitoring air quality in the atmosphere i.e. sample collection, trace detection facilities
- Air quality measurements

### Microgravity and Human Space Technology - MHST

- Simulating microgravity experiments that are performable in the space environment as it affects food security and drug/vaccine developments

### Atmospheric Research Software and Instrumentation Development - ARSID

- Indigenous development of Software and Instrumentation for Atmospheric Research
- Real-time maps of atmospheric parameters over Nigeria
- Now-cast of space weather over Nigeria
- Control of capital flight



### CAR AND HER SPACE RESEACRH LABORATORIES

S/N	Laboratories	Location	Year
1	National Air Quality Research Laboratory (NAQRL)	University of Ilorin, Kwara State.	2014
2	Space Environmental Research Laboratory (SERL)	NASRDA headquarters Abuja	2015
3	Space Earth-Environmental Research Laboratories (SEERL)	University of Benin, Edo State	2016
4	Space Weather Atmospheric Physics (SWAP)	Bayero University Kano, Kano State	2017
5	Atmospheric and Space Weather Research Laboratory (ASWeRL)	Osun State University, Osogbo, Osun State.	2017
6	Central Laboratory for Atmospheric Research (CLAR)	Anyigba, Kogi State.	2017

Table 1: CAR & Research Laboratories





# 2019 HIGHLIGHT REPORT

[www.carnasrda.com](http://www.carnasrda.com)



## **INSTALLATION OF INDIGENOUSLY MADE AUTOMATED HYBRID WEATHER STATION**

In the space of six years, CAR has installed a total of 28 functional weather station under the TRODAN project and a minimum of 8 locally built magnetometers installed across the country. The indigenously made automated hybrid weather station measures some atmospheric parameters and few Greenhouse Gases (GHGs) on real time basis at 1-minute interval and transmit same at near real time to dedicated server for global usage. It consists of a weather proof enclosure which contains highly reliable data logger powered on 130watts solar panel, 12V, 40Ah battery and 10A charge controller. The weather

station is equipped with a standard set of sensors which takes records of: air temperature, relative humidity, wind speed and direction, soil temperature and moisture at four different depths of 10cm, 20cm, 30cm and 40cm respectively, barometric pressure, sun intensity, evapotranspiration, rain rate, ozone, carbon dioxide and carbon monoxide etc. SD card is used for data recording and storage while psychometrics software is used for real time observation via a computer system. The station is a fully configured, solar powered, automated weather station.

## **INSTALLATION OF SWONON MAGNETOMETER**

The SWONON magnetometer also uses an SD card for data records and storage which can also be observed on real time via the psychometrics software while been powered on a 12V, 18Ah battery using a 30W solar panel and 10A charge controller. It was designed for long term unmanned or unattended operation and is ideal for meteorological and space weather monitoring and climate study applications.

In the year under review, nothing less than 6 weather stations and magnetometers were installed in various institutions cross Nigeria. The installation team comprised of: Engr. Adeyemi A, Engr. Saleh Umar A, Mr. Suleiman Abdulrahman, and Mr. Ezekiel Joshua. Successful regular routine checks and facility maintenance of existing stations were also carried out.

## MAINTANANCE OF INSTALLED AtPaM AT RUFUS GIWA POLY-TECHNIC (RUGIPO) OWO, ONDO STATE.

The installation and maintenance team of CAR arrived Rufus Giwa Polytechnic (RUGIPO) Ondo State on Monday - 27<sup>th</sup> May, 2019 for physical observation and maintenance exercise of the AtPaM station which was successfully installed in the premises of the tertiary institution in November, 2018.



*Figure 2: AtPaM station at Rufus Giwa Polytechnic, Owo, Ondo State*



*Figure 3: Magnetometer huts construction at Bowen University, Iwo*



## INSTALLATION OF HIGH PRECISION TELEMETRY WEATHER MONITORING STATION AND MAGNETOMETER AT BOWEN UNIVERSITY, IWO, OSUN STATE.

CAR's team of installation engineers and computer scientists, Engr Saleh Abubakar Umar, Mr. Suleiman Abdulrahman, Mr. Ezekiel Josiah arrived Bowen University, Iwo, Osun State on the Tuesday 28<sup>th</sup> May, 2019 for site inspection and facility installation of CAR's locally made Weather Station and Magnetometer which were both donated for installation was successfully concluded on the 29<sup>th</sup> of May, 2019. The team also did maintenance check on the Davis Pro station at the Faculty of Agriculture of the University. Data from the AtPaM is accessed by downloading the data logged in the

data logger of the AtPaM either through the memory card or transferred to the server through telemetry. Bowen University currently hosts assorted facilities such as Space Weather and Earth's Movement Monitoring Magnetometer, Hybrid Automated Atmospheric Parameters Monitor, and GNSS receiver for monitoring Space Weather. The University is gearing up for a ground breaking feat as she anticipates the arrival of the first ever Super Dual Auroral Radar Network (SuperDARN) in West Africa which is capable of transforming Upper Atmospheric Research in that region.



*Figure 4: Mr. Ezekiel, Mr. Suleiman and Engr. Saleh with the BOWEN team at the AtPaM installation Site*



*Figure 5: CAR Engineers constructing the solar panel carrier*



Figure 6: Engr. Saleh troubleshooting Davis Pro

## SWONON MAGNETOMETER INSTALLATION AT OBAFEMI AWOLOWO UNIVERSITY, ILE-IFE, OSUN STATE.

On Friday the 31<sup>st</sup> of May, 2019, the CAR team installed a fully functional SWONON magnetometer at the Department of Geology, Obafemi Awolowo University, Ile Ife, Osun State

in the Space Earthquake Laboratory. Upon successful installation, the facility was handed over to the institution to enhance research participation and output.



Figure 7: Engr. Saleh, Mr. Ezekiel, Mr. Suleiman working on the magnetometer at OAU Ile-Ife



Figure 8: Mr. Ezekiel and Mr. Suleiman at OAU Ile-Ife



## INSTALLATION OF ATMOSPHERIC PARAMETERS MONITOR (AtPaM) STATION AT UNIVERSITY OF BENIN, BENIN, EDO STATE.

Installation exercise commenced on Saturday - 1<sup>st</sup> June, 2019 at the University of Benin, Benin City, Edo state as the Centre's installation team arrived the premises for an on-site inspection to assess the domain most suitable for the mast, panel stand and erection of perimeter fence. By the following day being Sunday - 2<sup>nd</sup> of June, 2019 all sensors to the AtPaM station had been

fully configured by the seasoned team from the Centre for Atmospheric Research, the installation was a success and was functional upon handing over. The CAR team was led by Engr. Umar Saleh alongside other staff: Mr Abdulrahman Suleiman, Mr Josiah Ezekiel, Mr Timiyo Justice and Mr Alex Orukpe.



Figure 9: The team working at the AtPaM station at the University of Benin together with SEERL Benin Staff



Figure 10: CAR- NASRDA Staff; L-R: Mr Justice Timiyo, Mr Suleiman, Mr Josiah Ezekiel, Abdulrahman, Engr Umar Saleh, Mr Alex Orukpe during the installation.

## INSTALLATION OF AtPaM AT SERL-CAR, ABUJA

On Monday - 3<sup>rd</sup> June, 2019 the Installation of Atmospheric Parameter Monitor (AtPaM) was done at CAR-SERL,

Abuja. The aim of installing the equipment was to incorporate and enhance the monitoring of ground level parameters such as wind speed, evaporation

rate, solar radiation intensity, greenhouse gases ( $\text{CO}_2$ ,  $\text{NO}$  &  $\text{O}_3$ ) among

others for research purposes at the laboratory.



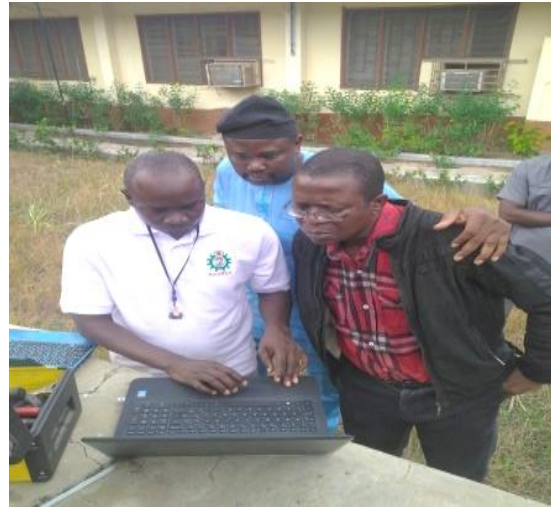
*Figure 11: The team at the AtPaM Installation site at SERL-CAR, Abuja.*

## **INSTALLATION OF AtPaM AND MAGNETOMETER AT LAUTECH OGBOMOSO, OYO STATE.**

CAR's installation team arrived at LAUTECH Ogbomoso on Thursday - 30<sup>th</sup> June, 2019 to fully troubleshoot and rectify the TRODAN station located at in the University premises where the team also discovered that battery powering the equipment had flattened

amongst other issues identified. In the overall, the team successfully replaced the faulty components identified during trouble shooting and restored the TRODAN station to its full functionality to aid research.

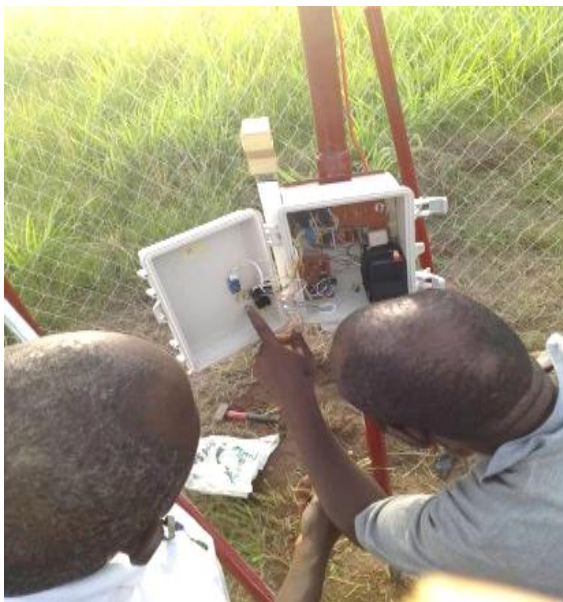




*Figure 12: Mr. Ezekiel, Engr. Saleh, Mr. Adewale, Mr. Suleiman, Prof. Oni and Dr George during the installation of TRODAN station at LAUTECH.*

## **INSTALLATION OF AtPaM AND MAGNETOMETER AT OSUN STATE UNIVERSITY, OSOGBO, OSUN STATE.**

The installation team from CAR arrived at Osun State University Osogbo, Osun State on the 30<sup>th</sup> of June, 2019 to install the weather station. The station was successfully installed following a careful assessment of the terrain for a conducive location. Thereafter, the station mast, perimeter fence was erected alongside configuration. The station was handed over fully powered by alternative solar energy.



*Figure 13: The team checking the sensor installed in the weather station is picking signal*



*Figure 14: The team working hard to installed the weather station at Osun State University, Osogbo*

## INSTALLATION OF MAGNETOMETER AT MOUNTAIN TOP UNIVERSITY (MTU), OGUN STATE.

On the 1<sup>st</sup> of July 2019, CAR team of Engineers and Scientists proceeded to Mountain Top University, Ogun state to install the SWONON Magnetometer. The installation was successful, and the benefit resonated on both sides such that whilst the institution celebrated the benevolence of the Centre toward

entrenching research, the CAR team are becoming more proficient in actualising the Centre's mandate and so, continuous staff training for the team cannot be overemphasised to further equip the team with adequate skill needed to carry out more of these advanced installations across the country.



*Figure 15: CAR team with the MTU team at the magnetometer installation site at the University on 1<sup>st</sup> of July 2019*



## INSTALLATION OF SWONON MAGNETOMETER AT UNIVERSITY OF LAGOS (UNILAG) LAGOS STATE.



*Figure 16: Prof. Oyeyemi of UniLag and his team with CAR team working at the installation site at Unilag 2<sup>nd</sup> - 3<sup>rd</sup> July, 2019*





*Figure 17: Dr. Rose of Chemistry Department, Prof. Oyeyemi of Physics department and CAR team at Atmospheric Chemistry Equipment trouble-shooting site Unilag 2<sup>nd</sup> - 3<sup>rd</sup> July, 2019*

## INSTALLATION OF SWONON MAGNETOMETER AT OLABISI ONABANJO UNIVERSITY



*Figure 18: Prof. Chukwuma of OOU, his team and CAR during the installation of magnetometer at Olabisi Onabanjo University 3<sup>rd</sup> -5<sup>th</sup> July 2019*



*Figure 19: Getting ready to take equipment live online after installation*



*Figure 20: Engr. Saleh Conducting the training after the installation of the magnetometer at OOU on 3<sup>rd</sup> -5<sup>th</sup> July 2019*



*Figure 21: The OOU Librarian Presenting Gift to the CAR team from the Vice Chancellor after installation hand- over on.*

## **AtPaM AND MAGNETOMETER INSTALLATION AT ABIA STATE UNIVERSITY, UTURU, ABIA STATE**



*Figure 22: ABSU team and CAR team after the maintenance and successful training on AtPaM at ABSU 10<sup>th</sup> – 12<sup>th</sup> July, 2019*





Figure 23: Magnetometer huts construction

### INSTALLATION OF SWONON MAGNETOMETER AT SERL, ABUJA.

The wireless Space Weather Observation Network Over Nigeria (SWONON) Magnetometer was installed on 8<sup>th</sup> April, 2019 at the Space Environment Research Laboratory,

Abuja. The successful installation was carried out by the Centre's team of Scientist, part of which were Miss Onyinye Gift, Mr Kashim Dauda and a visiting Scientist Mr. Efua Ogorbor.



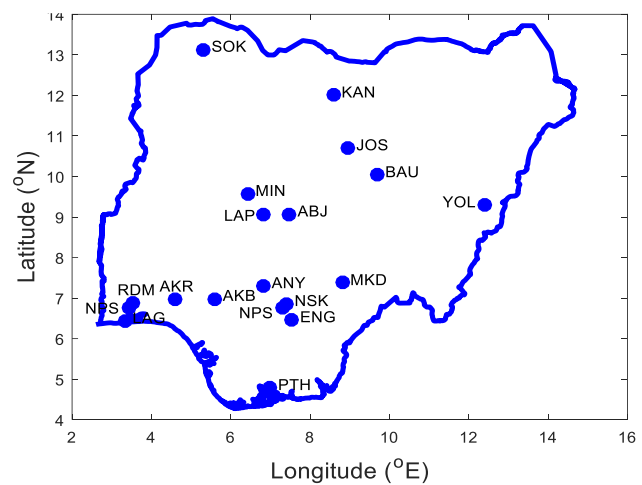
Figure 24: Installation process of Atmospheric Parameter monitor (AtPaM) by our scientist, Miss Onyinye Gift, Mr Kashim Dauda and visiting scientist, Mr Efua Ogorbor.

## MAINTENANCE OF EXISTING 19 STATIONS

Through the year 2019, the Centre was actively involved in the maintenance of her 19 existing stations across Nigeria, as well as initiating and executing new installations across the country.

Below are Stations Installation, including dates and & codes.

1. UNN ... July 2007	NSK
2. UNIABUJA ... July 2007	ABJ
3. UNILAG ... October 2007	LAG
4. UNIAGRIC MAKURDI ... October 2008 (2015)	MAK
5. UNIJOS ... March 2008	JOS
6. FUT, MINNA ... February 2008	MIN
7. RSUST, PH ... February 2008	PHT
8. AAU, AKUNGBA ... July 2008	AKB
9. CBSS PERM SITE ... July 2008	NPS
10. UTHMAN DAN FODIYO UNIV, SOKOTO ... May 2008	SOK
11. FUT, YOLA ... November 2009	YOL
12. FUT, AKURE ... May 2010	AKR
13. IBB UNIV, LAPAI ... May 2010	LAP
14. CAR AYINGBA ... July 2010	AYB
15. Redeemer's Univ. 2010	RDM
16. ESUT. 2012	ENU
17. LAUTECH 2012	OGM
18. ATBU, BAUCHI April 2013	BAU
19. BUK, Kano May 2017	KAN



## INSTALLATION OF NEW FACILITIES IN 2019

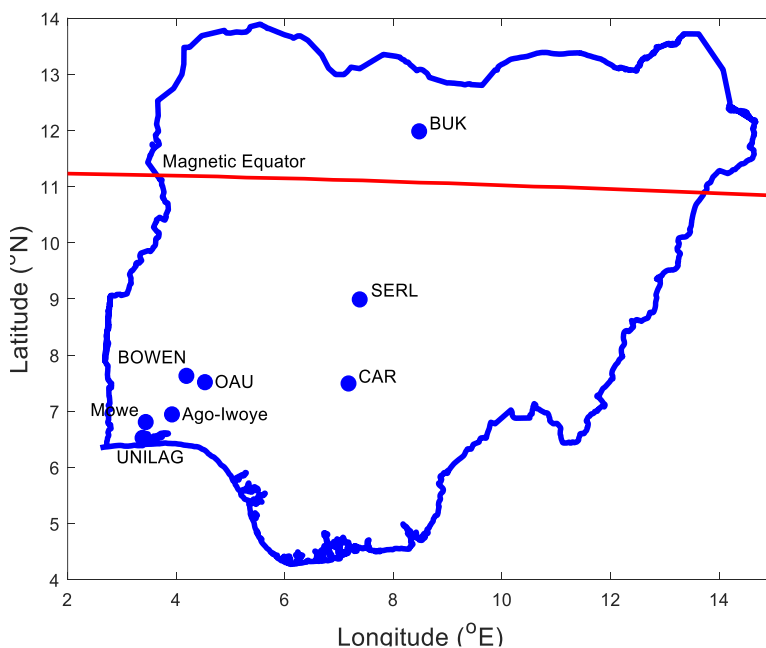


Figure 25: Installation locations for 2019



Figure 26: Lab built magnetometer Sensor



## ACTIVITIES SUPPORTED AND ORGANISED BY THE CENTRE

During the course of the year, the Centre for Atmospheric Research engaged in various programmes in consonance with its mandate, some of which are listed below:

### Staff Retreat

The 2019 retreat held on the 31<sup>st</sup> of January 2019 and served as a beautiful opportunity for all staff to be familiar with set skill to enhance productivity i.e. skills such as techniques of human rela-

tionship; team management and customer relationship; administrative procedure and process; scientific research and development and uses of new innovated software.

### Commissioning of the Space Environment Research Laboratory on the 25<sup>th</sup> of April, 2019

The Space Environment Research Laboratory of CAR was commissioned on the 25<sup>th</sup> of April, 2019 by the Honourable minister of Science and Technology, Dr Ogbonnaya Onu. Also, in attendance at the commissioning was Prof. S. O Mohammed DG NASRDA, Senator (Prof) Robert Ajayi Boroffice (Pioneer DG NASRDA) and other dignitaries within and outside the ministry of Science & Technology.



Figure 27a: His Excellency, Dr. Ogbonnaya Onu, Honourable Minister of Science and Technology unveiling the Space Environment Research Laboratory SERL



Figure 27b: The Honourable Minister being conducted round the facility at SERL by the Director. Senator (Prof) R. A. Boroffice, Chair of Senate committee on Science and Technology, in white flowing gown.

### WASCAL FUTA Python Training 13<sup>th</sup> - 17<sup>th</sup> May, 2019.

The Centre in collaboration with WASCAL DRP-WACS at Federal University

of Technology Akure organized a one-week free Python training program.

The workshop which held at WASCAL, FUTA. The Program was designed to cover general introduction to python programming and applications to climate data with the aim of strengthen the capacities of Nigerian scientists in analyzing datasets and using modern programming language such as python program to enhance capabilities in ana-

lysing in-situ and climate model dataset in addition to develop python modules and algorithms in teaching and research. CAR staff in attendance were: Mr Adejuwon Olalekan, Mr Sulieman Abdulrahman, Ms Yomi Awe, Miss Kemi Kayode, Miss Onyinye Nwankwo, Mr Dayo Afolabi, Mr Kashim Dauda.



Figure 28: Participants at the WASCAL/CAR College training on Application of Python Program to Atmospheric Data Analysis at Federal University of Technology, Akure on May 13<sup>th</sup> -17<sup>th</sup> 2019

### **America Geophysical Union (AGU) 100 Outreach Themed: “Catch Them Young for Geosciences”.**

The American Geophysical Union (AGU) 100 Outreach themed ‘Catch Them Young for Geosciences’ held at Imaguero College Hall, Benin City, Edo State, Nigeria 11th July, 2019 with about 380 students from 15 Schools across Edo State, participated in the event which was generously organized

by Edo State Government in collaboration with American Geophysical Union & Centre for Atmospheric Research, Popularization of Emerging Science and Technology Initiative, Women's Dignity Initiative Inc, and Network of Space- Earth Environmentalists.

The outreach was aimed at celebrating the Centenary of AGU and to showcase some beautiful results and benefits of Geosciences to youths in a bid to plant the seed of interest for Science in their youthful minds. The event also allowed the Centre to establish student-mentor program for a number of pupils who showed interest in developing a career in Geosciences. Notable guest speakers at the outreach were; Prof Babatunde Rabi (Director/Chief Executive, Centre for Atmospheric Research, NASRDA); Prof Jacob Ehiorobo (Geologists and Former Deputy Vice-Chancellor, UNIBEN); Dr Mrs Folasade Olajuyigbe a distinguished Biochemists

and a Fulbright Scholar. The Special guest of Honour, was the Executive Governor of Edo State, Mr. Godwin Nogheghase Obaseki was represented by the Permanent Secretary, Ministry of Science and Technology, Mrs Birgita Okodugha. In her speech, she expressed her appreciation to the Centre for Atmospheric Research for choosing Edo State as the beneficiary of the AGU 100 outreach program. She further stated that the event will compliment Edo-Best Initiative, promote a student-mentor program for a number of pupils who might show interest in developing career in Geosciences.



*Figure 29a: A group photo of participants at the 'Catch Them Young for Geosciences' held at Imaguero College Hall, Benin City, Edo State, Nigeria*





*Figure 29b: Prof Babatunde Rabi (Director/Chief Executive, Centre for Atmospheric Research, NASRDA), observes as the Permanent Secretary of the Ministry of Science and Technology, Edo State, Mrs Birgita Okodugha appreciates the special guest speaker, (Mrs) Folasade Olajuyigbe (Distinguished Biochemists and a Fulbright Scholar)*



*Figure 29c: Cross section of participants during the Catch them young in Geosciences held in Benin City.*

### **CAR University Support Programme: Joint Research Programme with African Universities**

- Joint research programme with post-graduate research students (MSc & PhD)
- Promote the lab's research visibility in projects that are useful and applicable for sustainable development



## The Inter-University Corporation for Atmospheric Research IUCAR

The IUCAR was conceived to be a conglomeration of researchers & institutions with interest in atmospheric and space sciences:

- set up a one-stop database for all researchers and institutions with relevance in atmospheric sciences
- provide a meeting platform for all researchers in fields of relevance to atmospheric sciences in Nigeria
- foster effective partnership among researchers of similar scientific interest
- promote international competitive research among members
- promote professionalism and instill sound academic culture in members
- establish a formidable team capable of forming alliance with international teams with the aim of pursuing long-term scientific programs and work with CAR and other national entities to promote research, observational programs, training and formulation of policies of relevance to atmospheric sciences in Nigeria.

### The YESPV-NIGBEN Project Kick-Off Meeting Held at The University of Nigeria, Nsukka from 5<sup>th</sup> -7<sup>th</sup> August 2019

A team of scientists from Institute of Energy and Climate Research (IECR), Julich Germany, led by Prof. Rau Uwe were received by Prof. Babatunde Rabiun (Director/CE, Centre for Atmospheric Research) and Mrs. Aderonke Obafaye (CAR-NASRDA) at the Nnamdi Azikiwe International Airport, Abuja on 3<sup>rd</sup> August, 2019 ahead of a kick off meeting with the University of Nigeria, Nsukka, Centre for Atmospheric Research (CAR-NASRDA), the National Centre for Energy & Climate Research and Development and the

German Institute of Energy and Climate Research (IECR), Julich. The project, titled *"Yield Analyses and Socio-economic Impact Assessment of Photovoltaic and Photovoltaic-powered food and energy hybrid systems in Tropical Nigerian Climate"* (YESPV-NIGBEN) is a One Million Six Hundred & Twenty-Nine Thousand Euro (€1,629,000,00) funded project by the German Ministry of Education and Research (BMBF). Other partners in the project are SUNFarming GmbH, Germany, WASCAL Headquarters, Ghana and University of Abomey Calavi, Benin Republic. The aim of the project is



to implement, characterize, monitor and analyze the yield/performance and socio-economic impact of PV and PV-powered greenhouse in the SUN-Farming integrated food and energy concept in tropical Nigerian climate. Participants were introduced to YES-SPV-NIGBEN by Dr. Agbo Solomon (Project Coordinator). Thereafter, partners involved in the project took turns

to deliver a 20 minutes presentation about their projects.

The presenters included:

- Prof. Uwe Rau -FZJ Germany
- Dr. Moumini Savadogo - WASCAL
- Mr. Holger Schoenherr- Sunfarming
- Prof. Julien Adoukpe -University of Abomey Calavi
- Prof. Babatunde Rabi- CAR NASRDA



Figure 30: Mrs. Aderonke Obafaye presenting a bouquet to the Leader of the team from Germany (Prof. Rau Uwe) on their arrival in Abuja while Prof Babatunde Rabi- looks on.

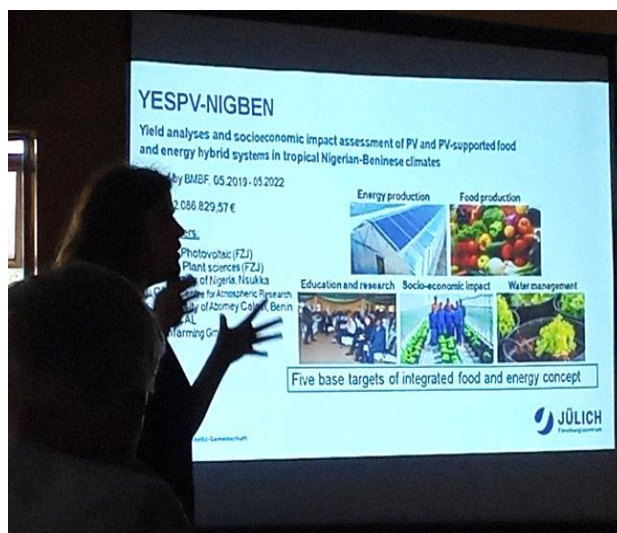


Figure 31: Dr. Merdzhanova Tsvetelina making a presentation on the YESPV-NIGBEN Project



Figure 32: A group photo of all the Project partners including the Local Organising Committee



Figure 33: Prof. Rau paying keen attention to Prof Uguru's farm tour in company of Prof Paulinus Ugwuoke and Dr. Solomon Agbo



### 3<sup>rd</sup> E.E BALOGUN NATIONAL AIR QUALITY WORKSHOP

The 3<sup>rd</sup> Ekundayo Elisha Balogun National Symposium and 2019 National Air Quality Workshop organized by The Centre for Atmospheric Research (CAR) and Bowen University to look at 'Air Quality issues in National Planning in Nigeria: assessing present status and predicting future trends in Nigeria' held at the seminar room, Timothy Olagbemiro Library, Bowen University, Iwo, Osun State on the 28<sup>th</sup> - 30<sup>th</sup> August 2019.

The host, Prof. Joshua Ogunwole, VC Bowen University, gave the welcome address by welcoming all guest especially Professor Emeritus E.E Balogun a pioneer weather forecaster in Nigeria and a distinguished icon of Atmospheric Research in Africa. The Director/CE of CAR Professor Babatunde Rabi, who was the convener of the event, gave the good will message on behalf of CAR and read Prof. E.E Balogun's biography.

In notable attendance were the Special Guest of Honour Prof. Sani Abubakar Mashin DG/CE of Nigeria Metrological Agency (NiMET) ably represented by Dr. Clinton Davidson-Ezekwe. Notable people who gave paper presentation were:

Prof. C.O. Akoshile of the Physics Department of the University of Ilorin presented a paper on 'Air Quality Issues in National Planning: Assessing Present status and Predicting Future Trends'; Dr Salihu Sa'id Associate Professor of Atmospheric Physics of Bayero University Kano presented a paper on 'Air Quality Research in Academia: Some findings and Future Research at Bayero State University, Kano State'; Dr. Rose A. Alani. Group leader, Air Quality Monitoring Research Group, Department of Chemistry, Faculty of Science, University of Lagos, delivered a paper on 'The Present Status of Air Quality and the Prediction of Future Trends'. Dr Clinton Davidson-Ezekwe identified the paramount challenge in air quality planning as lack of archived data and emphasized the need to have technologies that are tailor made to our social environment. Emeritus Professor E. E. Balogun appreciated all organisers and participants of the 2019 symposium and emphasized the need for further research on air quality and push for significant inclusion of air quality in national planning. Paper and Postal presentations were made by





various institutions and individuals. Other CAR staff Present at the event were, Mr. Najib Yusuf, Dr. Seun Ajileye,

Aladodo, S. S., Otu, J. O., Sani, M., Yomi Awe, Engr. Oluwaseye Adedoja and Eze Francis.



Figure 34: Group photo of organisers and participants with Professor and Mrs E.E Balogun at the National Symposium and 2019 National Air Quality Workshop

### **International Colloquium on Equatorial and Low-Latitude Ionosphere (ICELLI), Lagos, Nigeria, 9<sup>th</sup> -13<sup>th</sup> September 2019.**

The International Colloquium on Equatorial and Low-Latitude Ionosphere (ICELLI) organized by the Centre for Atmospheric Research (CAR-NASRDA) and Network of Space Earth Environmentalists (NSEE) took place at the University of Lagos, Akoka, Nigeria on 9<sup>th</sup> – 13<sup>th</sup> September, 2019 with forty (40) participants in attendance. Six (6) lecturers including Prof. Babatunde Rabiun and Prof. Victor Chukwuma of Olabisi Onabanjo University, Ago-Iwoye, Ogun State. The International Colloquium being the first in its series in Africa serves as a capacity building platform for African young scientists towards space weather forecasting, utilization of equatorial orbit in satellite technology among other benefits. The event featured a composition of tutorials, seminars, conference and hands on training on every aspect of research and techniques

bordering on the dynamics of equatorial and low latitude ionosphere as well as space weather. The program of the Colloquium includes discussions of the rather wide range of phenomena, such as: equatorial ionosphere, equatorial electrojet, equatorial ionospheric anomaly, geomagnetic disturbances, geomagnetically induced currents, solar-terrestrial relations, stratospheric warming, space weather, theory and modelling of Ionospheric Scintillation and Irregularities, presentation of results from different and novel techniques for probing the equatorial ionosphere etc.

The five-day event served as an effective meeting point for scientists, policy makers, students and designers of space-dependent technologies.



*Figure 35: Prof. Babatunde Rabi flanked by a cross Section of Participants at the International Colloquium on Equatorial and Low-Latitude Ionosphere (ICELLI) organized by the Centre for Atmospheric Research (CAR-NASRDA) and Network of Space Earth Environmentalists (NSEE) held at the University of Lagos, Lagos.*

### **The Nigerian Meteorological Society International Conference Held at the Federal University of Technology Akure, Between 1st and 4th December 2019 on the Theme “Climate Change: Challenges and Prospects. “**

The Nigerian Meteorological Society organized a 4-day national conference and 32<sup>nd</sup> annual general meeting to address various issues of global climatic

change. The theme of this year’s conference is “CLIMATE CHANGE: CHALLENGES AND PROSPECTS”. The conference attracted seasoned academics, professionals and policymakers within



the broad spectrum of science of weather and climate as more than seventy (70) well-researched papers on scientific evidence of climate change, sector and impact assessment and climate change awareness were presented and there were robust discussions and interactions on these papers.

Highlight of the event was the consensus reached by experts (on the urgent need to search for sustainable alternatives to replace the existing energy sources depleting and degrading the environment causing adverse effects on the climate which has become a critical threat in Nigeria) at the opening ceremony of the 3rd International Conference and Annual General Meeting of the Nigerian Meteorological Society (NIMETs) held at the Department of Meteorology and Climate Science, Federal University of Technology, Akure with the theme Climate Change: Challenges and Prospects, on December 2, 2019.

Delivering the keynote address DG/CEO, Nigerian Meteorological Agency (NiMet) Professor Sani Abubakar Mashi represented by Professor Peter Odjugo said the challenges posed by the threat of climate change has necessitated the search for al-

ternative sources of energy that will reduce Green House Gasses and release of carbon dioxide emissions. Furthermore, the Director General said NIMET is deploying its expertise to combat climate change effects in Nigeria through mounting fully automated weather stations, generating data for research, seasonal rainfall prediction, quality weather review, and drought review and crop weather calendar. Also speaking at the event was the President, Nigerian Meteorological Society, Professor Clement Akoshile who said climate change knows no barrier because the parameters that causes it is global and non-discriminating. Prof. Akoshile said the conference is out to examine and proffer workable solutions to the challenges of climate change.

The Vice Chancellor, Professor Joseph Fuwape represented by the Deputy Vice Chancellor, Professor Philip Oguntunde in his welcome remark said climate change poses a threat to the natural foundations of our lives and has become an essential threat to Nigeria. There were lead papers from keynote speakers. Professor Babatunde Rabi, Director/Chief Executive, Centre for Atmospheric Research, CAR,





NARSDA, presented a thought-provoking paper on 'Climate Change: Myth or Reality'. He emphasized that climate change has become a reality much faster than all scenarios predicted. He further stated that climate change is not just an environmental issue, as too many people still believe but an all-encompassing threat, to health, to agriculture, to peace and security, to

the very ground millions of people live on, to the global economy. We are now at a point where even the international community has given up denying this reality. The new IPCC assessment report says that humanity has time until 2020 that is next year, to reverse the path of constantly growing GHG emission.



Figure 36: Dr Seun Ajileye ably representing the Director of CAR, Prof. Babatunde Rabi'u with Ms Yomi Awe of CAR

## PARTICIPATION IN CONFERENCES AND WORKSHOPS

The Centre for Atmospheric Research (CAR) actively participated in the following conferences and workshops listed below:

### Science & Technology Exhibition, Enugu, Nigeria (14<sup>th</sup>-18<sup>th</sup> Jan. 2019)

The Centre participated in the one-week Science and Technology exhibition held in Enugu that took place on the 14<sup>th</sup> of January to 18<sup>th</sup> of January. The event was attended by Engr. Umar Saleh, Mr Suleiman, and Mr Ezekiel. The technical staff of CAR in their usual professional gesture, confidently set up displayed CAR's indigenously fabri-





cated High Precision Telemetry Weather Monitoring Station (SWONON) and Magnetometer all built at Central Laboratory for Atmospheric Research (CLAR), Anyigba as well as data from it.

### **National Mathematical Centre, Training**

The National Mathematical Centre, Abuja on the 22<sup>nd</sup> – 3<sup>rd</sup> of May, 2019 organized a two-week scientific foundational programme at the National Mathematical Centre Auditorium, Abuja designed for graduate, post graduate students and lecturers who have interest in understanding Relativistic Astrophysics. This knowledge is believed to form the bedrock for advanced research in relativistic astrophysics and cosmology. Miss Onyinye Gift Nwankwo, a Scientific Officer of Lower Atmosphere Unit was selected for this training.

### **Nigeria Geophysical Society (NGS) 6th Annual International Conference.**

Nigeria Geophysical Sciences (NGS) held her 6<sup>th</sup> annual international conference themed: *Exploring the diversity in geophysical sciences for national development* on 7<sup>th</sup> - 10<sup>th</sup> May, 2019 at Michael and Cecilia Ibru University (MCIU) Agbara-Otor, Ughelli, Delta State. The event was supported by the Centre for Atmospheric Research, and Prof Babatunde Rabiou was the Conference Keynote speaker. During the three-day event, topics such as: Space Weather, Solar Physics Communication, Magnetosphere, Lower Atmosphere/Troposphere, Meteorology, Remote sensing, Hydrocarbon Exploration, Mineral Exploration etc were taken.

### **ICTP Trieste (Italy) International Space Weather Initiative Workshop (ISWI) 2019**

The Abdul Salam International Centre for Theoretical Physics, Trieste Italy organized and hosted the International Space Weather Initiative Workshop (ISWI) on the 20<sup>th</sup> - 24<sup>th</sup> May 2019. The International Space Weather Initiative (ISWI) is a programme of international cooperation to advance space weather science by a combination of instrument deployment, analysis of space weather data from these instruments in conjunction with other data, and the communication of such results.



The programme was well put together, diverse and in-depth as it attracted a total of 115 experts from 31 Nations across the Globe. The workshop which is aimed at the deployment of instruments in developing nations and analysis of space weather data with particular focus on new research results and findings and to encourage greater cooperation in developing partnerships and ISWI networks. The International Committee on Global Navigation Satellite Systems (ICG), Boston College and the Scientific Committee on Solar Terrestrial Physics (SCOSTEP) and the US Institute of Navigation are cosponsors of this workshop.

The programme touched on many topics and delineated grey areas in the field of theoretical physics with outcomes that significantly adds to existing knowledge in the academia as well as shed light on possible applications of the output of various research interests. Topics such as Instrumentation; Solar Physics; Magnetosphere, Ionosphere, and Thermosphere; Solar Terrestrial Coupling and Space Weather; Space Weather effects on Global Navigation Satellite Systems (GNSS); New Space Weather scientific results; Capacity Building, Education and Outreach were delivered. The workshop which was co-sponsored by the Centre for Atmospheric Research (CAR), United Nations Office for Outer Space Affairs, International Committee on Global Navigation Satellite Systems, Boston College, Scientific Committee on Solar Terrestrial Physics, National Aeronautics and Space Administration, International Space Weather Initiative, International Union of Geodesy and Geophysics, European Space Agency. Professor Babatunde Rabiun Director & Chief Executive CAR-NASRDA, Mr. Toyese Ayorinde of INPE-Brazil, Dr. Bola Abdulrahim of CSTD, NASRDA, and Mrs. Aderonke Obafaye of CAR-NASRDA actively participated in the UN workshop.



*Figure 37: Participants at the 2019 UN/Italy International Space Weather Initiative Workshop*

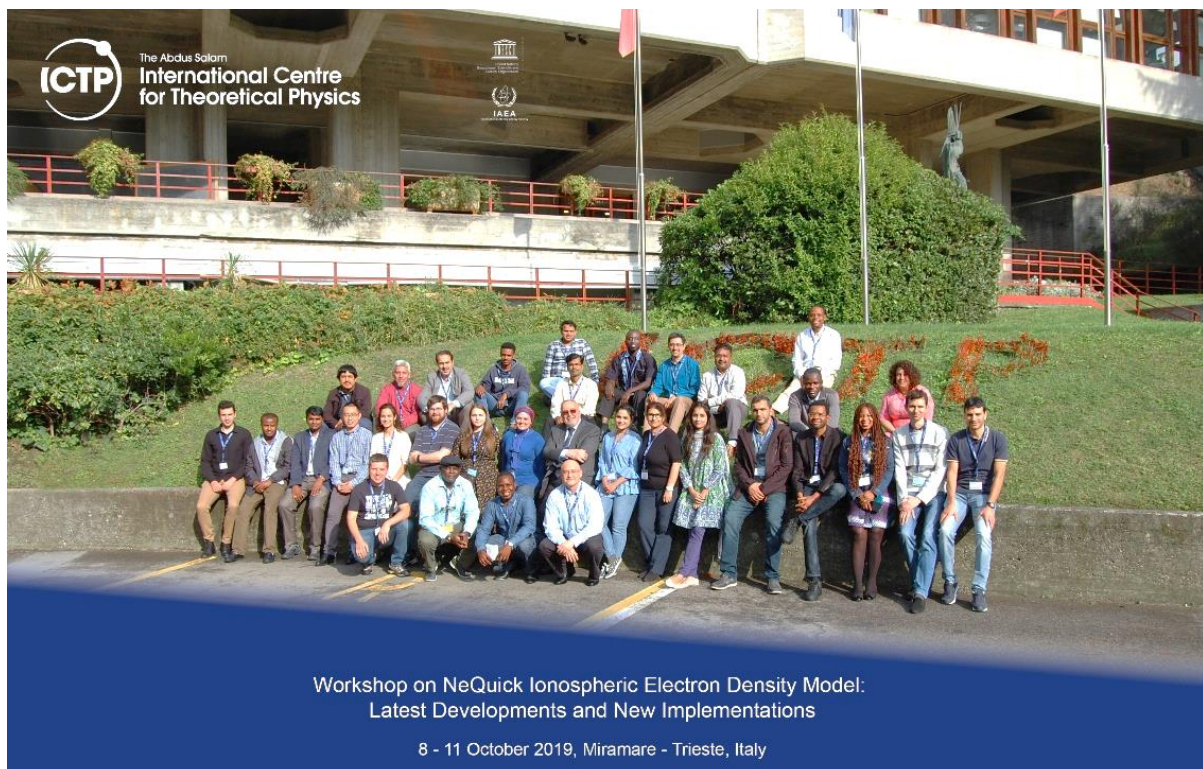
### **Forum on Science Objective and Observation System Workshop – Beijing, China.**

The international meridian circle, International Space institute meeting held in Beijing China between the 23<sup>rd</sup> - 25<sup>th</sup> September 2019 aimed at creating forum on science objective and observation with beneficial advantage for collaborative positioning was attended by the Digital Director, Prof. Babatunde Rabi.

### **Workshop on NeQuick Ionospheric Electron Density Model: Latest Developments and New Implementations 8th – 11th October, 2019, Trieste, Italy**

The four (4) day workshop organised by the Abdus Salam International Centre for Theoretical Physics ICTP, Trieste, Italy, in collaboration with the Institute for Geophysics, Astrophysics and Meteorology of the University of Graz, Austria, attracted 32 participants from 14 countries across the globe. The model (NeQuick-2) is the latest version of the ionosphere electron density model developed by the Telecommunications/ICT as a quick-run global 3D ionospheric electron density model specifically designed for trans-ionospheric propagation applications for the development of the ICTP. Dr Daniel Okoh and Mrs. Aderonke Obafaye of CAR-NASRDA were among the participants who gave presentations at the workshop.





*Figure 38: Cross Section of Participants at the Workshop on NeQuick Ionospheric Electron Density Model*

## COLLABORATIVE PARTNERSHIPS

As the Centre continues to take giant strides in achieving her set mandates, CAR credits her success to the unique and outstanding partnerships forged with collaborators over the years, who have shown commitment to be engaged in promoting research, field observations and capacity building in tandem with the Centre's operating modes.

### 2019 MOU Signed

- ✓ The Ondo State University of Science and Technology Okitipupa (OSUSTECH) signed an MoU with National Space Research and Development Agency (NASRDA)
- ✓ Institute of Energy and Climate Research, Julich, Germany



Figure 39: CAR collaborators; A few amongst many



Figure 40: CAR national collaborators

## WORKING VISITS

### Courtesy Visit to Edo State Governor, Mr Godwin Nogheghase Obaseki

On the 16<sup>th</sup> January, 2019 the Centre for Atmospheric Research led by The Director/CE Prof. Babatunde Rabiú paid a working visit to the Edo State Governor, His Excellency Governor Godwin Nogheghase Obaseki to help in providing scientific interventions towards the development of the state. In company of the Director/CE were Mr Kenneth Ogbeiwi, Engr. Seye Adedója, Mr Tebebi Justice, Mr Alex Orukpe, Mrs Aderonke Obafaye and Mr Jude Aghedo of CAR.



*Figure 41: CAR Director, Prof. Babatunde Rabi with the Executive Governor of Edo State, Mr. Godwin Nogheghase Obaseki during a courtesy visit to the later on talks to co-ordinate the space research and innovations in the state*

### **Visit to the Department of Atmospheric Sciences, University of Houston, 25 - 26 February 2019, Houston, USA**

The meeting was aimed at initiating a major collaborative research with CAR and the air quality research group of Professor Berrhard Rappenglueck of Department of Atmospheric Sciences, University of Houston, Houston, USA. Prof Babatunde Rabi Director/CE, was at the Department of Atmospheric Sciences, University of Houston, USA between 25 and 26 February 2019.

### **2019 Girls Astronomy Camp Lokoja**

CAR in collaboration with Astronomy Without Borders (AWB) on 10<sup>th</sup> May, 2019 organized a one-day Girls astronomy camp for about 39 schools with over 200 girls in attendance. The event which held at Salem University Lokoja had the Kogi State commissioner of Education, Science and Technology, Mrs Rosemary Osikoya on sit as the special guest of honour and the VC of Salem University, Prof. Dorcas Oluwade.





*Figure 42: L-R: Participants with the organisers of Girls Astronomy Camp; CAR Director, Prof. Babatunde Rabi, Mrs Rosemary Osikoya; the Honourable Commissioner of Education, Science and Technology Kogi State, the VC of Salem University; Prof. Mrs Dorcas Omanyu Oluwade and a member of Astronomers without Borders, Mr Timipre.*

### **Visit from Virginia Technology College of Engineering from Virginia, USA on 7<sup>th</sup> of June 2019.**

Prof. Wayne Scales of Virginia Tech, USA visited SERL- CAR and NASRDA on the 7<sup>th</sup> of June 2019. The visiting team and CAR are working in collaboration with Bowen University to set up the first ever Super Dual Auroral Radar Network (SuperDARN) in Africa.

### **Working Visit to Space Lab Uniben By Edo State Ministry of Science and Technology.**

A delegation from the Edo State Ministry of Science and Technology led by Dr C. I. Adesotu visited Space Lab., Uniben on 7<sup>th</sup> June, 2019. The visit was aimed at understanding the workings of the installed Hybrid Atmospheric Parameters Monitor (AtPAM) at the laboratory. They were conducted round the laboratory by Mr Alex Orukpe, liaison officer SEERL.



*Figure 43 : L-R: Prof Obahiagbon, Uniben Dean of Engineering, Prof Ehiorobo, Former DVC admin, Uniben, Dr. C. I. Adesotu, Honourable Commissioner for Science and Technology, Edo State, Dr (Mrs)Okodugha, Perm Sec, Ministry of Science and Technology, Edo state, Mr Alex Orukpe, CAR-NASRDA Liaison officer, Mr Alegbe, Director from Ministry of Science and Tech. and Mr Justice Timiyo*

### **German Delegate Visit to SERL - CAR on 8<sup>th</sup> August 2019.**

Following the successful closure of the YESPVIG-BEN meeting held with a team of five scientists from the German Institute of Energy and Climate Research (IECR), Julich, and SUNFarming GmbH in company of CAR Director, Prof. Babatunde Rabiun (refer to pages 30 & 31). A courtesy visit was made to the Acting DG and the entire Management of NASRDA on Thursday 8th August 2019. The guests are:

1. Prof Uwe Rau- Director, *Institute of Energy and Climate Research-Photovoltaic Research Centre, Julich. (Team Leader)*
2. Dr. Merdzhanova Tsvetelina, *Group Leader, Julich*
3. Dr. Solomon Agbo- *YESPVIG-BEN Coordinator, Scientists, Julich*
4. Engr David Morr- *Project Engineer, SUNFarming Company, Germany*
5. Mr Holger Schoenherr- *International Project Manager, SUNFarming Company, Germany.*

The delegates were received by the Ag DG, Mr. Jonathan Angulu together with some management staff. The team thereafter proceeded to visit the Space Environment Research Laboratory SERL-CAR which is a Laboratory actively managed by the Centre for Atmospheric Research located within at the Head Quarters of NASRDA Abuja. The Director/CE Prof. Babatunde Rabiú along with some staff of the laboratory were on ground to show them round. The team expressed a very high level of satisfaction with the operations of the laboratory. Consequently, Engr. Morr and Mr. Holger quickly used the opportunity of the visit to inspect the site where the PV systems would be installed.



*Figure 44: L-R: Dr. Solomon Agbo, Prof. Uwe Rau, Dr. Merdzhanova Tsvetelina, Engr David Morr and Prof. Babatunde Rabiú visiting CAR AtPaM location in SERL, Abuja.*



*Figure 45: L-R: The German Institute of Energy and Climate Research (IECR), Julich, and SUN-Farming GmbH meeting with the Ag. Director General NASRDA and her management team.*





## CAR VISITORS

Since Inception,

- Over 2000 visitors to CAR (SERL, NAQRL, SEERL, SWAP, ASWeRL and CLAR)
- Over 600 first time visitors to CAR
- Over 90 visiting scientists with PhD
- Over 40 Interns under the SIWES
- Over 24 graduates under the NYSC scheme
- Over 30 foreign Scientists (Germany, USA, South Africa, Senegal, Kenya, Benin Republic etc.)
- Over 400 visiting under-graduates from different part of Nigeria.
- Over 300 visiting graduates from different part of Nigeria.
- Over 500 visiting Primary and Secondary pupils from Nigeria

## CAREER DEVELOPMENT IN CAR

Research, Training and Development are part of the cardinal operations of CAR. The Centre prepares its identified manpower to address the unique responsibilities and challenges to achieve her set mandate. This is achievable through a combination of formal and informal trainings and development methodologies which includes sponsor of agency' engineers and scientists on Postgraduate Degrees i.e. M.Sc. & Ph.D. and professional certifications in highly reputable institutions both locally and internationally in relevant fields of space research to enrich knowledge and enhance the competence of the space scientists and technologists/engineers in NASRDA.

S/N	NAME	PROGRAMME	INSTITUTION
1.	Ogbeiwi Kenneth Osalumense	PhD Accounting	Igbinedion University, Okada
2.	Johnson O. Omotayo	M.Tech Food Science Tech	Federal University of Technology Akure



S/N	NAME	PROGRAMME	INSTITUTION
3.	Orukpe Alex Oseghale	MSc Plant Biochemistry	University of Benin
4.	Aghedo Jude	Master in Business Administration	Kogi State University
5.	Saleh Abubakar Umar	MSc Information Technology	NOUN
6	Mr. Tebebi Justice	MEng. Elect/Telecom Engineering	University of Benin
7	Musa I. A.	MSc Computer Science	Kogi State University

Table 2: CAR Staff who successfully completed Post Graduate & Doctorate Programmes

### STAFF UNDERGOING GRADUATE PROGRAMMES

S/N	NAME	PROGRAMME	INSTITUTION	STATUS
1.	Adedoya Oluwaseye S.	PhD Engineering	Tshwane University of Technology, Pretoria. South Africa	In progress
2.	Yusuf Najib	PhD Atmospheric Physics	Bayero State University	In progress
3.	Shehu Sara-fadeen A.	PhD Physics	University of Ilorin	In progress
4.	Saleh Abubakar Umar	PhD Electrical Engineering	Universiti TunHussein Onn. Malaysia	In progress
5.	Sani Muayiwa	PhD Atmospheric Physics.	Bayero University Kano	In progress
6.	Musa I. A.	PhD Computer Science	University of Nigeria, Nsukka	In progress
7.	Onuigbo Ifeanyi Francis	PGD in Electrical/Electronic Engineering	Enugu state University of Technology	In progress



S/ N	NAME	PROGRAMME	INSTITUTION	STATUS
8.	Onuh Joyce Ojonugwa	PGD Business Administration	Nasarawa State University, Keffi	In progress
9.	Obafaye Aderonke	MSc Environ- mental Physics	University of Agriculture Makurdi, Benue State	In progress
10.	Ogaji Friday Ateko	MSc	Kogi State University	In progress
11.	Gideon Ebo- serem	Master in Busi- ness Admin- istration	Nasarawa State University, Keffi	In progress
12.	Kashim Dauda	MSc. Space Physics	Institute for Space Science & Tech- nology, African University of Science & Technology, Abuja.	In progress
13.	Olalekan Adejuwon	M.Eng.	FUTA, Akure. Ondo state	In progress
14.	Onyinye Nkwankwo	MSc. Space Geo- physics	Instituto Nacional De Pesquisas Es- pacias (INPE), Brazil	In progress
15.	Isah Isiaka	M.Eng.	Nigerian Defence Academy. Kaduna state.	In progress
16.	O.O Afolabi	PhD. Space Geophysics	Instituto Nacional De Pesquisas Es- pacias (INPE), Brazil	In progress

*Table 3: Staff whose graduate/ Post graduate programmes are in progress*





## 2019 PUBLICATIONS BY STAFF OF CAR

1. Akoshile, C.O., **Shehu-Aladodo, S., Sani, M., Otu, J.O.** and Ajibola, B.T. (2019) Comparative Accuracy Assessment of Combined MODIS and NAAPS Aerosol Optical Depth with AERONET Data over North Africa. *Atmospheric and Climate Sciences*, 9, 398-420. <https://doi.org/10.4236/acs.2019.93028>
2. **O. O. Ajileye, S. S. Aladodo and A. B. Rabi.**, (2019) Spatio-Temporal Characterization of Land Surface Air Temperature Anomaly over Nigeria. *Physical Science International Journal*, 21(3): 1-9, DOI: 10.9734/PSIJ/2019/v21i330108
3. **Ajileye, O. O., Otu, J. O., Najib Yusuf and Rabi, A. B.**, (2019). Rainfall Intensity and Evapotranspiration Patterns Nexus Over Nigeria at Different Solar Cycles.
4. **Yusuf, N.**, Ekpe, O.E., Said, R.S. et al., (2019). Seasonal and diurnal trends of surface refractivity in a tropical environment using ground-based automatic weather stations. *Springer Meteorol Atmos Phys*. <https://doi.org/10.1007/s00703-019-00693-6>.
5. **Saleh, U. A., Felix A. S and Suleiman Abdulrahman**, (2019). Development of Web-Based Price Comparison System for Orgone Accumulator Based Farm Products and other Local Commodities. *International Journal of Information Technology*. ISSN: 2413-2950, Volume 3 Issues 1, 2019.
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#### INTRA-CENTRE TRAINING

1. Seminar: Presentation on “*An overview of quantum computing and its Application*” by Mr. Matthew Daniel of ICT unit on the 17<sup>th</sup> April 2019 Venue: Prof. Seidu Onailo Muhammed Conference Hall, Anyigba. Kogi State.
2. Computer Training: The ICT unit team organized on 3-weeks comprehensive computer training for all Industrial Training (IT) students at the centre from the 9<sup>th</sup> – 30<sup>th</sup> of September 2019. The training which was facilitated by the Head of ICT Mr Suleiman Abdulrahman covered topics ranging from Computer Appreciation and Desktop Publishing, Microsoft Word, Microsoft Excel and Microsoft PowerPoint.





*Figure 46: ICT Training for Industrial Training Students*

## **ADMINISTRATIVE UPDATE**

- A 3-day training on the Upload of TSA-Sub Account Transactions for 2019 into GIFMIS Platform for MDAs. The training was organized by the Office of the Accountant General of the Federation, Consolidated Account Department and was held at the TREASURY Academy, Orozo from Friday, 22<sup>nd</sup> to Saturday, 24<sup>th</sup> March, 2019. Dr. Ogbeiwi O. Kenneth and Mr. Shaibu Tijani Shaibu participated in the training.
- The Ministry of Budget and National Planning organised a 3- day training program on 2019 budget preparation using GIFMIS Budget Preparation Sub-system from Monday, 26<sup>th</sup> to 28<sup>th</sup> August, 2019. The venue of the training was Dominion International School Jabi, Abuja. The training was attended by DCAR, Prof. Babatunde Rabi, Head of Accounts, Dr. Kenneth O. Ogbeiwi, Head of Budget, Mrs. Onuh Joyce, Mrs. Aderonke Obafaye, Mr. Gideon Eboseremhen and Shaibu Tijani Shaibu. This training has equipped both the budget unit and the account unit to work together to foster a seamless 2020 budget for Personnel, Overhead and Capital for the Centre.



## PAPER PRESENTATIONS

1. Seasonal Analysis of Tropospheric Ozone and Its Precursors ( $\text{NO}_2$  &  $\text{CO}$ ) Over Africa Using Satellite Remote Sensing. Aladodo, S. S., Otu, J. O., Najib, Y., Sani, M., and Rabi, B. A. Workshop paper presented at Professor E. E. Balogun Symposium and 2019 Air Quality Workshop, Bowen University Iwo, Osun State on the 28<sup>th</sup> - 30<sup>th</sup> August 2019.
2. Characterization of Absorbing Aerosols Using Ground-Based AERONET Observation over Some Africa Locations. Aladodo, S. S., Akoshile, C. O., Ajibola, T. B., Sani M., and Iborida O. A. Submitted to Nigeria Meteorological Society Conference held at Federal University of Technology Akure on the 1<sup>st</sup> – 4<sup>th</sup> December 2019.
3. Analysis of the Impact of Nigerian Aerosols and Ozone on Climate and Air Quality in Tropical West, (2019). Najib Yusuf, Rabia, S. S., Simone Tilmes, and Emiola G. Seminar paper presented at Physics Department BUK.
4. Ozone Pollution and Anthropogenic Sectoral Emissions from CMIP and DICE Inventories in a Tropical Region, (2019). Najib Yusuf, Simone Tilmes, Rabia, S. S. and Emiola G. Seminar paper presented at Physics Department BUK and Poster Presentation at 2019 Air Quality Workshop, Bowen University, Iwo, Nigeria on Thursday 29<sup>th</sup> August 2019

## CAR CONGRATULATORIES

- Mrs Omotayo Oyewole was blessed with a baby boy on the 9<sup>th</sup> of March 2019
- Mr Walter Okey was blessed with a baby girl on the 15<sup>th</sup> of March 2019
- Mr. Najib Yusuf welcomed a baby boy on the 7<sup>th</sup> of April 2019
- Mr Gideon Eboseremhen was joined in holy matrimony to his heartthrob on the 28<sup>th</sup> of September 2019
- Ms Ndidi Amaka was joined in holy matrimony to her heartthrob on the 14<sup>th</sup> of December 2019



Figure 47: Mr Gideon Eboseremhen and wife



Figure 48: Ms Ndidiamaka Orungbe and husband flanked by CAR staffs.



Figure 49: Dr. Kenneth Ogbeiwi in a warm handshake with His Excellency, Dr. Goodluck Ebele Jonathan GCFR, (Former President of Nigeria) during his Ph.D. convocation at Igbiniedion University Okada on the 30<sup>th</sup> of November, 2019



## PICTURE PANORAMA

Pictures from 2019 Federal Ministry of Science and Technology Expo and Exhibition Program held at the Michael Opara Square Enugu State, Monday 14<sup>th</sup> – Friday 18<sup>th</sup> January, 2019. the Expo: Engr. Saleh A. U, Mr. Suleiman A. Member, Mr. Ezekiel J.



Figure 50: Engr. Saleh A. U, Mr. Suleiman A. Member, Mr. Ezekiel J setting up for their peach at the 2019 Science and Technology expo and exhibition program



Figure 51: Engr. Saleh explaining how the Atmospheric Parameter monitor (AtPaM) observes ground level parameters to curious students at the Science and Tech. Expo



Figure 52: Engr. Saleh explaining the working principles of our locally designed magnetometer to the Assessment Team.



Figure 53: Dr. Chizia (Director PPP), Dr. Benjamin Ayantunji (Asst. Director) and CAR Staff Joyfully holding NASRDA 1<sup>st</sup> position award.

Pictures from the 4-day training on Automatic Weather Station (AtPaM), Operation and maintenance of staff from Forestry Research Institute of Nigeria, Ibadan Oyo State on 4<sup>th</sup>-7<sup>th</sup> February, 2019.



*Figure 54: CAR technical staff with staff from Forestry Research Institute of Nigeria, Ibadan Oyo State onsite training on Automatic Weather Station (AtPaM)*



*Figure 55: CAR technical staff with staff from Forestry Research Institute of Nigeria, Ibadan Oyo State upon completion of a four-day training on operation and maintenance of Automatic Weather Station*





Figure 56: Three days training/testing of High Precision Telemetry Weather Monitoring Station (AtPaM) for technical staff at CAR Laboratory from 22<sup>nd</sup>-24<sup>th</sup> May, 2019.



Figure 57: Exhibition of NASRDA 20<sup>th</sup> Anniversary Celebration on 5<sup>th</sup>-7<sup>th</sup> May, 2019.





Figure 58: L-R Dr Okere Bonaventure; Director of CBSS, Kevin Govender; Director of Astronomy of Development, International Astronomical Union, Cape Town South Africa with the Director of CAR Prof. Babatunde Rabiun and the co-ordinator of SERL, Dr Daniel Okoh at the SERL facility inspection of the All sky optical imager.



Figure 59: Visit to the SERL facilities by Participants at the close of the Astronomical Society of Nigeria (ASN) Conference led by Prof. A.A. Ubachukwu.





*Figure 60: Night observation of the All sky optical imager by WAISSYA 2019 participants at SERL facilities*



*Figure 61: Standard astronomical telescope was on ground for use by the students at the AGU outreach 2019 in Benin.*





Figure 62: R-L Organisers of Girls Astronomy Camp; Astronomers without Borders team, CAR well represented by her Director, Prof. Babatunde Rabi, with Mrs Rosemary Osikoya; the Honourable Commissioner of Education, Science and Technology Kogi State in the middle and the VC of Salem University; Prof. Mrs Dorcas Omanyu Oluwade



Figure 63: Director of CAR, Prof. Babatunde Rabi, Presenting some of our research findings to dignitaries at the CAR stand during the 20<sup>th</sup> anniversary of NASRDA. In white flowing gown is Senator (Prof) Robert Ajayi Boroffice, the pioneer DG NASRDA, to his left in black suit is Professor Ibadapo Obe, the former VC UNILAG and former president, Nigerian Academic of Science.



*Figure 64: Girls guided to view the Sun using dedicated sun-viewing glasses at the Girls astronomy camp 2019 in Lokoja.*



*Figure 65: Prof Babatunde Rabi with Prof. Uwe Rau, Dr. Merdzhanova Tsvetelina, Engr David Morr from IECR Julich Germany at SERL*





Figure 66: L-R: Dr Elijah Falayi, Dr. Rabia Saidu, Prof. Babatunde Rabi, Prof. Ibiyinka Fuwape at the 2019 Nigeria Geophysical Sciences (NGS) 6<sup>th</sup> annual international conference in MCIU



Figure 67: Professor E.E Balogun about to receive an honorary lapel from the VC of BOWEN, Prof. Joshua Ogunwole



Figure 68: Poster exhibition during the E.E Balogun symposium by the Head of R&D Mr Najib Yusuf.



Figure 69: More Poster exhibition during the E.E Balogun symposium



*Figure 70: Mr Kashim Dauda of SERL taking Graduate and Research students of Institute for Space Science & Technology, African University of Science & Technology, Abuja on facility tour at SERL.*



*Figure 71: The Vice Chancellor of FUTA and his entourage visiting the CAR-ASWeRL stand during the FUTA EXPO Workshop '19; More Than Certificate @ FUTA*



## ACRONYMS

CAR	-	Centre for Atmospheric Research
NASRDA	-	National Space Research Agency
CBSS	-	Centre for Basic Space Science
NCAR	-	National Centre for Atmospheric Research
UK	-	United Kingdom
ICELLI	-	International Colloquium on Equatorial and Low-Latitude Ionosphere
TRODAN	-	Tropospheric Data Acquisition Networks Project
GPS	-	Global Positioning System
MAGDAS	-	Magnetic Data Acquisition System
AMBER	-	African Mediterranean B-Field Education and Research
SOFIE	-	Solar Flares detected by Ionospheric Effects
SERL	-	Space Environment Research Laboratory
SEERL	-	Space Earth-Environment Research Laboratory
SWAP	-	Space Weather and Atmospheric Physics Laboratory
ASWERL	-	Atmospheric and Space Weather Research Laboratory
CLAR	-	Central Laboratory Atmospheric Research
SWONON	-	Space Weather Observation Network over Nigeria
ACER	-	Atmospheric Chemistry and Environment Research
MHST	-	Microgravity and Human Space Technology
FPI	-	Fabry - Perot Interferometer
GNSS	-	Global Navigation Satellite Systems
ARSID	-	Atmospheric Research Software and Instrumentation Develop- ment
NAQRL	-	National Air Quality Research Laboratory
GHGs	-	Green House Gases
AtPAM	-	Atmospheric Parameters Monitor
UNILAG	-	University of Lagos



UNIBEN	-	University of Benin
MFM	-	Mountain of Fire Miracles
AGU	-	American Geophysical union
WASCAL	-	West African Science Service Centre on Climate Change and Adapted Land Use
SCOSTEP	-	Scientific Committee on Solar Terrestrial Physics
ICTP	-	International Centre for Theoretical Physics
NMets	-	Nigeria Meteorological Society
NiMET	-	Nigeria Meteorological Agency
IUCAR	-	Inter-University Corporation for Atmospheric Research ESS Engineering and Space Systems
SWONOA	-	Space Weather Observation Network over Africa
KSU	-	Kogi State University
CE	-	Chief Executive
DG	-	Director General
R&D	-	Research & Development
IECR	-	Institute of Energy and Climate Research
NSEE	-	Network of Space Earth Environment
NGS	-	Nigeria Geophysical Science
ISWI	-	International Space Weather Initiative
ICGSS	-	International Community on Global Navigation Satellite System
AOD	-	Aerosol Optical Depth
AOT	-	Aerosol Optical Thickness
AERONET	-	Aerosol Robotic Network
ICT	-	Information Communication Technology
MoU	-	Memorandum of Understanding
AWB	-	Astronomy Without Borders
VC	-	Vice Chancellor
NOUN	-	National Open University of Nigeria
IOSR	-	International Organisation Scientific Research Journal of





## Electrical Electronics Engineering

ESUT	-	Enugu State University of Science and Technology
BUK	-	Bayero University Kano
USA	-	United States of America
LA	-	Lower Atmosphere
UA	-	Upper Atmosphere
ISEE	-	Institute for Space-Earth Environmental Research
MDAs	-	Ministries, Departments and Agencies
DSA	-	Defence Space Administration
IPPIIS	-	Integrated Personnel Payroll Information System
IPSAS	-	International Public Sector Accounting Standard
UNN	-	University of Nigeria, Nsukka
BSRN	-	Baseline Surface Radiation Network
ICE14	-	International Conference and Exhibition on Environmental Issues
NDA	-	Nigerian Defence Academy
STP	-	Solar Terrestrial Physics
WASSIYA	-	West African International Summer School for Young Astronomers
IAU OAD	-	Astronomy of Development, International Astronomical Union

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